

Collision Notes and Practice Problems 4th Block 10.6.11

A 0.50 kg object is at rest. A 3.00 N force to the right acts on the object during a time interval of 1.50 s.

a) What is the velocity of the object at the end of this interval?

b) At the end of this interval, a constant force of 4.00 N to the left is applied for 3.00 s. What is the velocity at the end of the 3.00 s?



$$a) \quad \bar{F}_1 \Delta t_1 = m \Delta \bar{v}_1 = m(\bar{v}_{1f} - \bar{v}_{1i})$$

$$\begin{aligned} v_{1f} &= \frac{\bar{F}_1 \Delta t}{m} \\ &= \frac{(3.0 \text{ N})(1.5 \text{ s})}{0.5 \text{ kg}} \\ &= +9 \text{ m/s} \end{aligned}$$

$$b) \quad \bar{F}_2 \Delta t_2 = m(v_{2f} - v_{2i}) \quad v_{2i} = v_{1f}$$

$$\begin{aligned} v_{2f} &= v_{2i} + \frac{\bar{F}_2 \Delta t}{m} \quad \bar{F}_2 = -4.0 \text{ N} \\ &= 9 \text{ m/s} + \frac{(-4 \text{ N})(3 \text{ s})}{(0.5 \text{ kg})} \\ &= -15 \text{ m/s} \end{aligned}$$

HW : due Friday, 10/7

p. 201 : 1-3

Conservation of Momentum:

$$\vec{P}_i = \vec{P}_f$$

$$\vec{P}_{1i} + \vec{P}_{2i} + \dots = \vec{P}_{1f} + \vec{P}_{2f} + \dots$$

Collisions:

- Two types:
 - Perfectly elastic
 - ↳ hit-and-bounce
 - perfectly inelastic
 - ↳ hit-and-stick
- choose +/- directions
- Rotate your axes to make life easier
- Equations:

- perfectly elastic, 2 objects

$$\vec{P}_{1i} + \vec{P}_{2i} = \vec{P}_{1f} + \vec{P}_{2f}$$

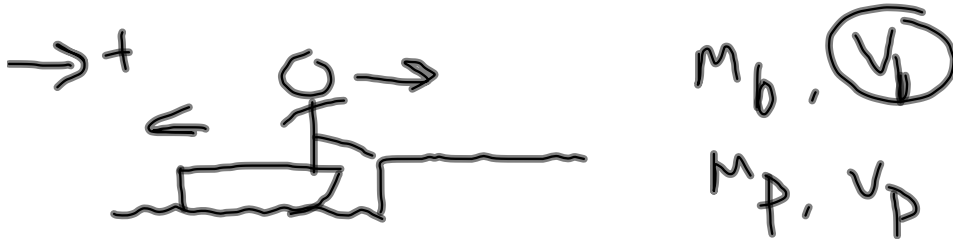
$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = m_1 \vec{v}_{1f} + m_2 \vec{v}_{2f}$$

- perfectly inelastic, 2 objects

$$(m_1 + m_2) \vec{v}_i = m_1 \vec{v}_{1f} + m_2 \vec{v}_{2f}$$

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = (m_1 + m_2) \vec{v}_f$$

A 76 kg boater, initially at rest in a stationary 45 kg boat, steps out of the boat and onto the dock. If the boater moves out of the boat with a velocity of 2.5 m/s to the right, what is the final velocity of the boat?



$$(m_b + m_p) \vec{v}_i = m_p \vec{v}_{pf} + m_b \vec{v}_{bf}$$

$$\begin{aligned} v_b &= - \frac{m_p v_p}{m_b} \\ &= - \frac{(76 \text{ kg})(2.5 \text{ m/s})}{45 \text{ kg}} \\ &= -4.22 \text{ m/s} \end{aligned}$$

A boy on a 2.0 kg skateboard initially at rest tosses an 8.0 kg jug of water in the forward direction. If the jug has a speed of 3.0 m/s relative to the ground and the boy and skateboard move in the opposite direction at 0.60 m/s, find the mass of the boy.